

BIOLOGICAL SEMICONDUCTORS

SUMMARY

The National Cancer Institute's Cancer Diagnostic Program and the Food and Drug Administration's Center for Devices and Radiological Health is seeking statements of capability or interest from parties interested in collaborative research to further develop, evaluate, or commercialize biological semiconductors as diagnostic sensors.

REFERENCE NUMBER

E-040-2009

PRODUCT TYPE

- Diagnostics

KEYWORDS

- POC
- point of care diagnostics
- personalized medicine
- high throughput screening
- nanotechnology
- biosensor
- rapid diagnostics

COLLABORATION OPPORTUNITY

This invention is available for licensing.

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DESCRIPTION OF TECHNOLOGY

This invention describes a new biological semiconductor based on the electrical percolation of single-walled carbon nanotubes (SWNTs). The nanotubes are embedded with biological ligands (e.g., antibodies). The electrical resistance of a semiconducting SWNT increases dramatically upon the actuation by a specific antigen. Measurement of the change in resistance correlates with the concentration of the specific antigen and thus provides for quantitative determination of biological samples.

Fabrication using printing technologies of electrical percolation biological semiconductors (BSC) can facilitate assembly of numerous types of gates containing various ligands (e.g., antibodies, DNA, etc.) and can be used to assemble many of such gates on the same chip. This feature would enable the creation of biological "central processing units" for various biomedical applications, including direct biodetection and regulation of implantable biomedical devices.

R&D Status: Pre-clinical proof of concept was demonstrated. For example, using anti-Staphylococcal Enterotoxin B (SEB) IgG antibodies as a ligand on the gate, and the SEB antigen as an actuator, the inventors could detect as little as 0.1 ng/mL of SEB.

Further R&D Needed:

- Develop a simple and portable biosensor platform based on the semiconductor
- Develop electronics, microfluidics, and software to utilize the chip

POTENTIAL COMMERCIAL APPLICATIONS

- Miniaturized biosensors for various biomedical applications, including: i) direct biodetection of microbial pathogens and their toxins; ii) diagnostics and prognostics of human diseases (e.g. cancer, cardiovascular, or other biomarkers); iii) detection and analysis of nucleic acids (e.g. DNA, RNA); iv) detection and analysis of other analytes (carbohydrates, fatty acids, organic or inorganic compounds).
- Point of care diagnostics and personalized medicine
- Rapid or real time diagnostics
- Monitoring of food safety and detection of environmental pollution
- Regulation and activation of implantable biomedical devices such as insulin pumps or artificial hearts
- New generation of personal detectors (e.g. food allergens, cardiovascular event, etc.)

COMPETITIVE ADVANTAGES

- The electrical percolation biological semiconductors (BSC) are relatively simple to assemble, and do not require specialized fabrication facilities or experience
- Can be fabricated into the same chip enabling simultaneous detection of many analytes.
- Electronic-based BSC detection enables simple digital signal amplification and analysis.
- Enable rapid or real time measurements
- Relatively stable with respect to retention of biological viability and thus can be stored for long period of time before use
- BSCs are relatively low cost devices, simple to use and may not require special equipment or a skilled operator.

INVENTOR(S)

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DEVELOPMENT STAGE

- Prototype

PATENT STATUS

- **U.S. Filed:** US Application No. 13/128,851 filed 11 May 2011

THERAPEUTIC AREA

- Immune System and Inflammation